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(54) **ACOUSTICAL PANEL**

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E04B 1/00 (2006.01)
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E04B 1/84 (2006.01)

(52) **U.S. Cl.**

CPC **E04B 1/86** (2013.01); **E04B 2001/8461** (2013.01)

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,376,396 B1	4/2002	Thorn	
6,541,105 B1 *	4/2003	Park	..... C08J 9/0061
			521/142
8,720,642 B1 *	5/2014	Beckervordersandforth	.....
			G10K 11/172
			181/290
11,224,823 B2 *	1/2022	Hospodor	..... F02B 63/04
11,541,626 B2 *	1/2023	Bush	..... B32B 27/12
2007/0287001 A1 *	12/2007	Carlson B60R 13/0838
			428/312.2

(Continued)

FOREIGN PATENT DOCUMENTS

KR 10-1123260 B1 3/2012

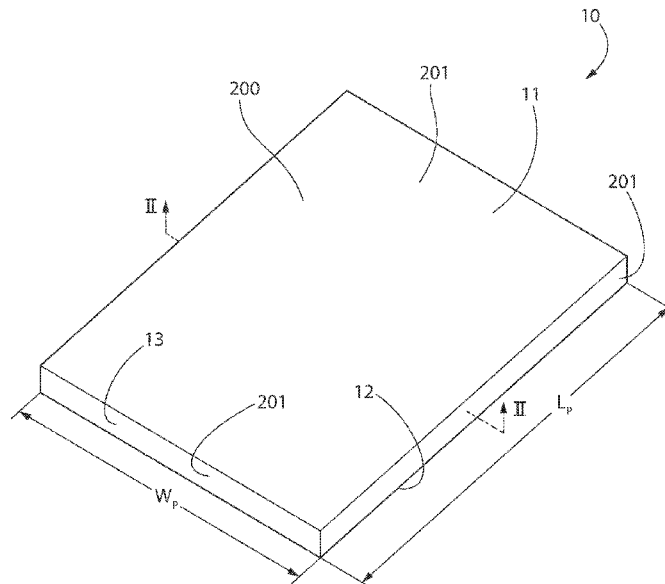
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(57) **ABSTRACT**

Described herein are building panels and surface covering systems useful for spaces requiring acoustic control and design flexibility, and methods to prepare the same. Such building panels and surface covering systems comprise an acoustic building panel having a first major surface opposite a second major surface and a side surface extending there-between, the acoustic building panel comprising a body having an upper surface opposite a lower surface and side surfaces extending there-between; a fleece having a first side and a second side; wherein the first side of the fleece is in contact with the upper surface of the body; wherein the body and fleece are laminated; and wherein the fleece has a resistivity of about 826,100 to about 1,090,900 Pa*s/m². In certain embodiments, building panels and surface covering systems have superior fire resistant qualities.

20 Claims, 6 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

2007/0298215	A1	12/2007	Nicolai	
2009/0085378	A1	4/2009	Borchardt	
2009/0159363	A1*	6/2009	Weber	..... A47B 83/04 181/290
2010/0000640	A1*	1/2010	Kierzkowski	..... B60C 5/00 152/209.2
2012/0037447	A1*	2/2012	Duval	..... B60R 13/08 181/290
2013/0112499	A1	5/2013	Kitchen	
2018/0030721	A1	2/2018	Ciuperca	
2019/0105868	A1	4/2019	Zhou	
2020/0024844	A1*	1/2020	Jacek	..... B27N 3/04
2020/0027436	A1*	1/2020	Shackleford	..... B32B 5/32
2020/0102742	A1*	4/2020	Augustinas	..... E04C 2/284
2020/0338867	A1	10/2020	Luttwak	
2021/0339279	A1*	11/2021	Yancey	..... B05D 3/067
2022/0134968	A1*	5/2022	Ortega B32B 5/026 181/290

* cited by examiner

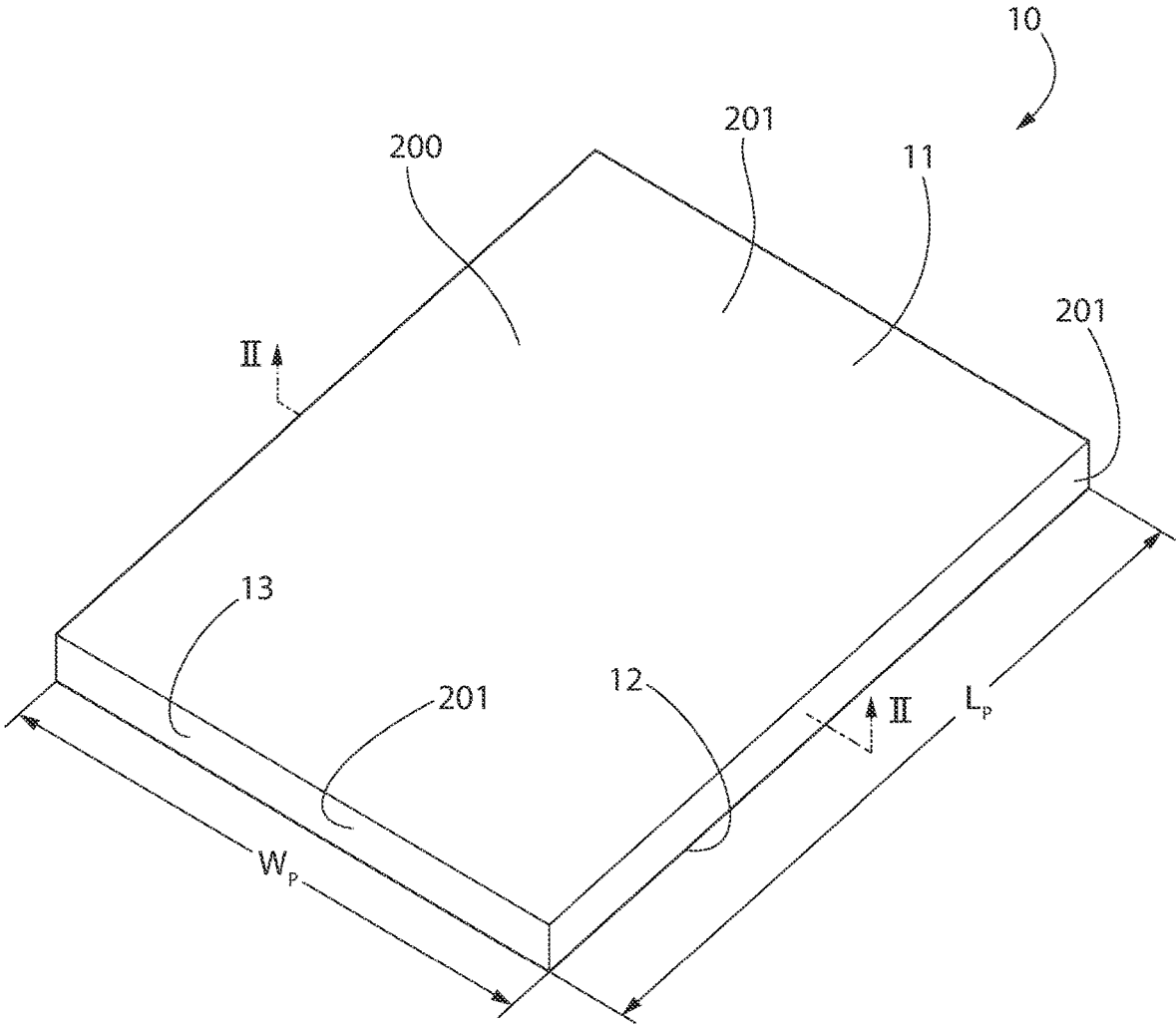


FIG. 1

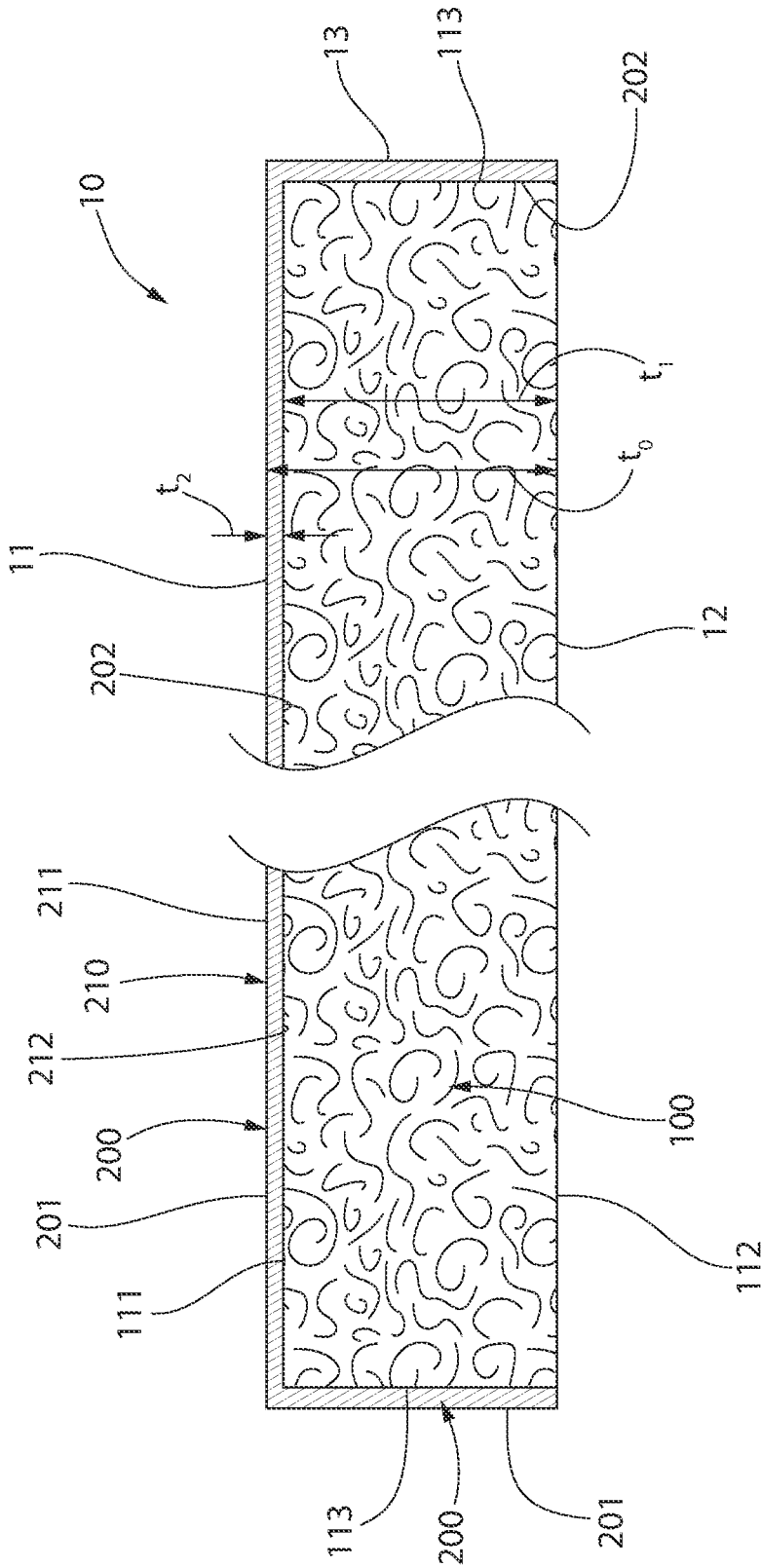


FIG. 2

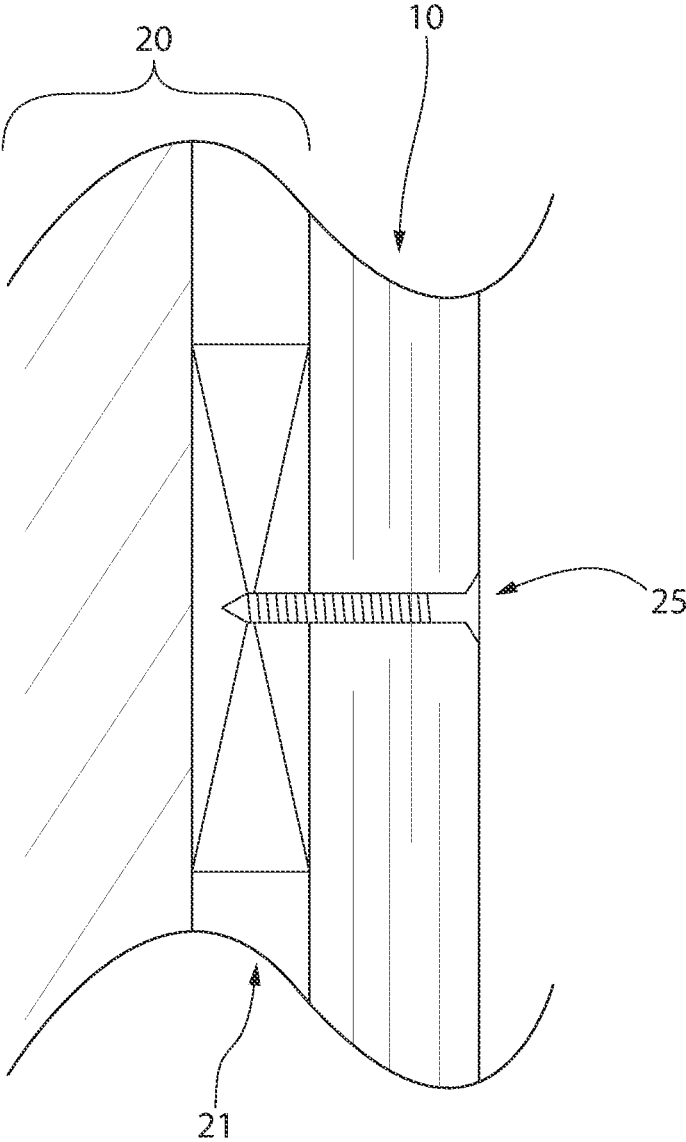


FIG. 3

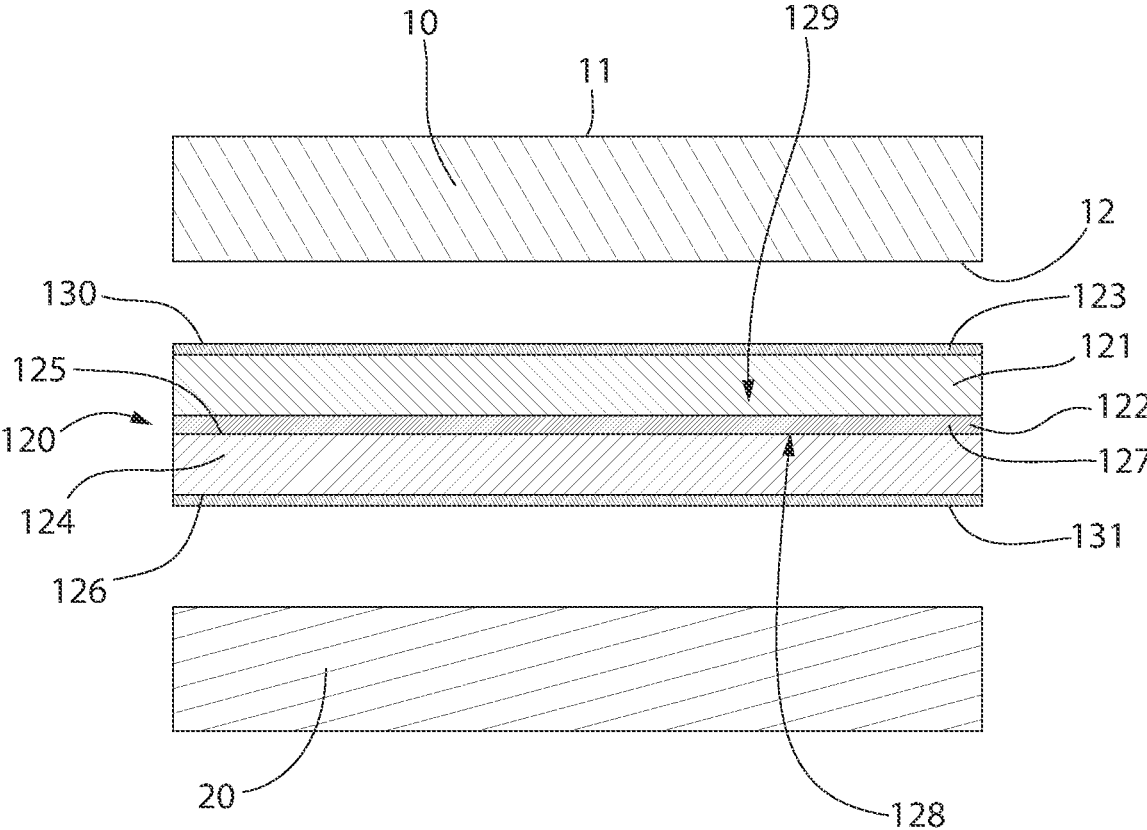


FIG. 4

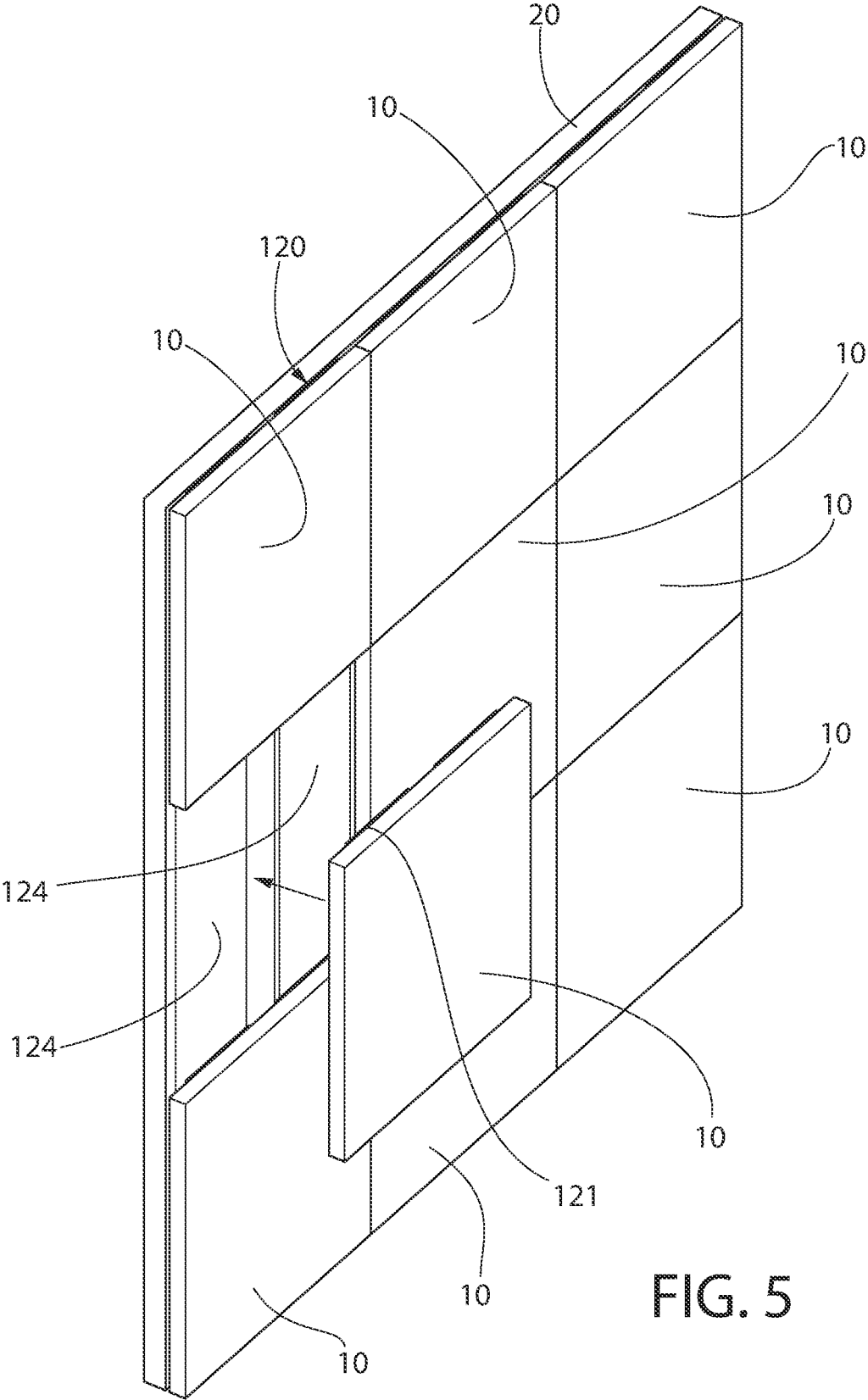


FIG. 5

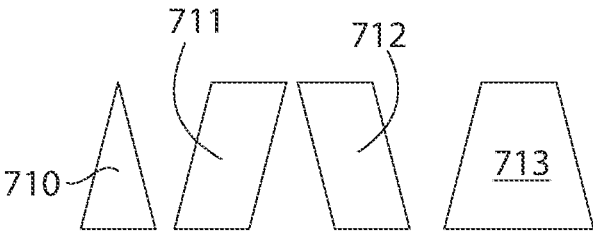


FIG. 6A

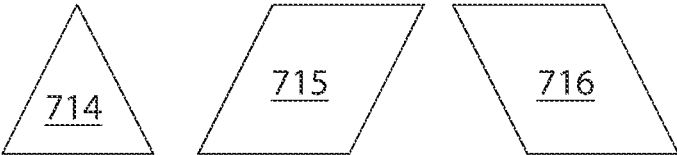


FIG. 6B

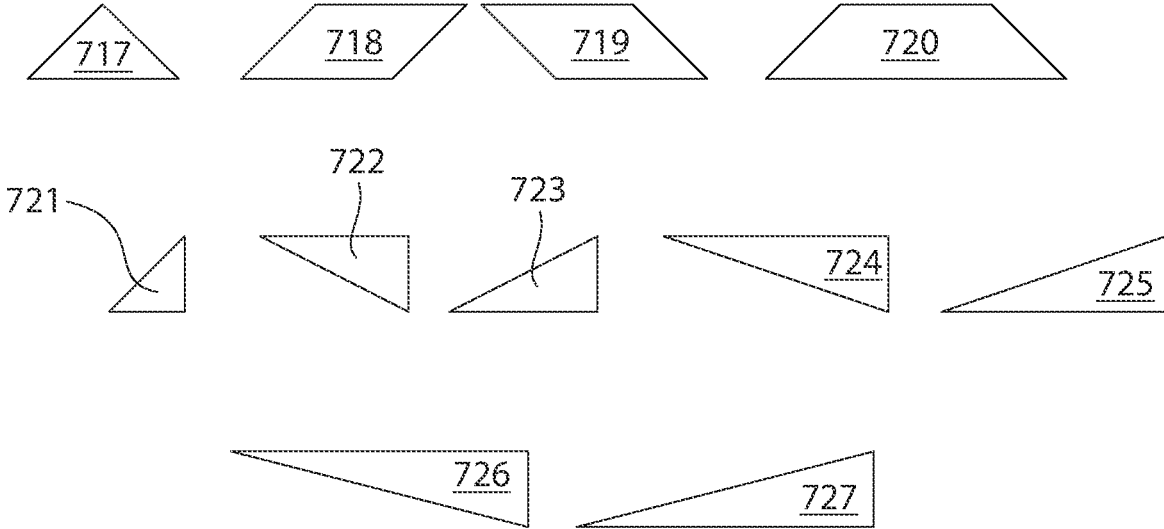


FIG. 6C

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ACOUSTICAL PANEL**CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims the benefit of U.S. Provisional Patent Application No. 63/229,600 filed on Aug. 5, 2021. The disclosure of the above application is incorporated herein by reference.

FIELD OF THE DISCLOSURE

The present disclosure relates to acoustical panels for use in building materials, and more particularly to highly acoustical nonwoven composite panels having superior fire resistant qualities.

BACKGROUND

Surface coverings are used for a variety of reasons, including to cover up imperfections in an underlying surface, to display a desired aesthetic, and to introduce acoustical solutions, such as providing beneficial sound absorption. Examples of such surface coverings includes flooring that covers a subfloor, ceiling panels that cover a ceiling, and wall panels that cover a wall. Such surface coverings may be provided in various shapes, sizes, and forms in order to meet aesthetic and acoustical requirements.

However, surface coverings can be expensive to use due to material component costs and overall weight. Furthermore, it would be beneficial to obtain surface coverings which provide for improved acoustical characteristics, such as having beneficial Noise Reduction Coefficient (NRC). Surface coverings must also be in conformance with building flammability regulations.

Thus, there is a need for improved surface coverings having cost and weight effective characteristics without compromising acoustical or fire preventive properties. Embodiments of the present invention are directed to meeting these needs.

SUMMARY

This summary is intended merely to introduce a simplified summary of some aspects of one or more implementations of the present disclosure. Further areas of applicability of the present disclosure will become apparent from the detailed description provided hereinafter. This summary is not an extensive overview, nor is it intended to identify key or critical elements of the present teachings, nor to delineate the scope of the disclosure. Rather, its purpose is merely to present one or more concepts in simplified form as a prelude to the detailed description below.

Applicants have discovered acoustic building panels useful to display a desired aesthetic quality and to introduce acoustical solutions. Such acoustic building panels also provide for beneficial fire preventive characteristics.

Thus, in certain embodiments, the present invention provides an acoustic building panel comprising a first major surface opposite a second major surface and a side surface extending there-between, the acoustic building panel comprising a body comprising an upper surface opposite a lower surface and a side surface extending there-between; a fleece having a first side opposite a second side; wherein the first side of the fleece is in contact with the upper surface of the body; the body and fleece are laminated; and wherein the fleece has a flow resistivity of about 826,100 to about

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1,090,900 Pa*s/m². In certain embodiments, the body comprises a nonwoven material. In certain embodiments, the body comprises aspen wood, non-woven perforated metal, or wood. In certain embodiments, the body comprises aspen wood excelsior. In certain embodiments, the distance between the upper surface and lower surface is about 0.8 inches to about 2.5 inches. In certain embodiments, the distance between the upper surface and lower surface is about 0.8 inches to about 1.2 inches. In certain embodiments, the distance between the upper surface and lower surface is about 1.0 inch. In certain embodiments, the fleece comprises fiberglass, sheep wool, cellulosic material, or non-woven polymer. In certain embodiments, the cellulosic material is selected from cotton, paper, or combinations thereof. In certain embodiments, the non-woven polymer is selected from polyester, polyolefin, polyaramid, or combinations thereof. In certain embodiments, the fleece has a flow resistivity of about 857,000 Pa*s/m². In certain embodiments, the body comprises fire retardant. In certain embodiments, the fire retardant is selected from magnesium oxide, sodium silicate, magnesium sulfate, calcium carbonate, or a combination thereof. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.65 to about 0.90 as determined in an E-400 mount. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.90 as determined in an E-400 mount. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.55 to about 0.60 as determined in a D-20 mount. In certain embodiments, the acoustic building panel has a flame spread index (FSI) of about 0 as determined by ASTM E84-20. In certain embodiments, the acoustic building panel has a smoke developed index (SDI) of about 5 or less as determined by ASTM E84-20. In certain embodiments, the acoustic building panel is a wall or ceiling panel.

In certain embodiments, the present invention is an acoustic building panel having a first major surface opposite a second major surface and a side surface extending there-between, the acoustic building panel consisting essentially of a body having an upper surface opposite a lower surface and side surfaces extending there-between; a fleece having a first side opposite a second side; wherein the first side of the fleece is in contact with the upper surface of the body; the body and fleece are laminated; and wherein the fleece has a flow resistivity of about 826,100 to about 1,090,900 Pa*s/m². In certain embodiments, the body comprises a nonwoven material. In certain embodiments, the body comprises aspen wood, non-woven perforated metal, or wood. In certain embodiments, the body comprises aspen wood excelsior. In certain embodiments, the distance between the upper surface and lower surface is about 0.8 inches to about 2.5 inches. In certain embodiments, the distance between the upper surface and lower surface is about 0.8 inches to about 1.2 inches. In certain embodiments, the distance between the upper surface and lower surface is about 1.0 inch. In certain embodiments, the fleece comprises fiberglass, sheep wool, cellulosic material, or non-woven polymer. In certain embodiments, the cellulosic material is selected from cotton, paper, or combinations thereof. In certain embodiments, the non-woven polymer is selected from polyester, polyolefin, polyaramid, or combinations thereof. In certain embodiments, the fleece has a flow resistivity of about 857,000 Pa*s/m². In certain embodiments, the body comprises fire retardant. In certain embodiments, the fire retardant is selected from magnesium oxide, sodium silicate, magnesium sulfate, calcium carbonate, or a combination thereof. In certain embodiments, the acoustic building panel has a noise

reduction coefficient (NRC) of about 0.65 to about 0.90 as determined in an E-400 mount. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.90 as determined in an E-400 mount. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.55 to about 0.60 as determined in a D-20 mount. In certain embodiments, the acoustic building panel has a flame spread index (FSI) of about 0 as determined by ASTM E84-20. In certain embodiments, the acoustic building panel has a smoke developed index (SDI) of about 5 or less as determined by ASTM E84-20. In certain embodiments, the acoustic building panel is a wall or ceiling panel.

In other embodiments, the invention is a surface covering system comprising a plurality of acoustic building panels, each of the panels comprising a first major surface opposite a second major surface and a side surface extending there-between, the acoustic building panel further comprising a body having an upper surface opposite a lower surface and side surfaces extending there-between; a fleece having a first side opposite a second side; wherein the first side of the fleece is in contact with the upper surface of the body; wherein the body and fleece are laminated; and wherein the fleece has a flow resistivity of about 826,100 to about 1,090,900 Pa*s/m²; and an adhesive tape configured to detachably couple the panels to a substrate, the adhesive tape comprising: a substrate-side adhesive component comprising at least one adhesive layer; a panel-side adhesive component comprising at least one adhesive layer; and a release component; wherein the panels are detachably coupled to the substrate by the adhesive tape in a side-by-side arrangement to cover the substrate, the at least one adhesive layer of the substrate-side adhesive component being adhered to the substrate, the at least one adhesive layer of the panel-side adhesive component being adhered to the rear surfaces of the panels, and the release component being positioned between the substrate-side adhesive component and the panel-side adhesive component. In certain embodiments, the body comprises a nonwoven material. In certain embodiments, the body comprises aspen wood, non-woven perforated metal, or wood. In certain embodiments, the body comprises aspen wood excelsior. In certain embodiments, the distance between the upper surface and lower surface is about 0.8 inches to about 2.5 inches. In certain embodiments, the distance between the upper surface and lower surface is about 0.8 inches to about 1.2 inches. In certain embodiments, the distance between the upper surface and lower surface is about 1.0 inch. In certain embodiments, the fleece comprises fiberglass, sheep wool, cellulosic material, or non-woven polymer. In certain embodiments, the cellulosic material is selected from cotton, paper, or combinations thereof. In certain embodiments, the non-woven polymer is selected from polyester, polyolefin, polyaramid, or combinations thereof. In certain embodiments, the fleece has a flow resistivity of about 857,000 Pa*s/m². In certain embodiments, the body comprises fire retardant. In certain embodiments, the fire retardant is selected from magnesium oxide, sodium silicate, magnesium sulfate, calcium carbonate, or a combination thereof. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.65 to about 0.90 as determined in an E-400 mount. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.90 as determined in an E-400 mount. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.55 to about 0.60 as determined in a D-20 mount. In certain embodiments, the acoustic building panel

has a flame spread index (FSI) of about 0 as determined by ASTM E84-20. In certain embodiments, the acoustic building panel has a smoke developed index (SDI) of about 5 or less as determined by ASTM E84-20. In certain embodiments, the acoustic building panel is a wall or ceiling panel.

Further areas of applicability of the present disclosure will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the disclosure, are intended for purposes of illustration only and are not intended to limit the scope of the disclosure.

DESCRIPTION OF THE DRAWINGS

The detailed description of the invention will be better understood when read in conjunction with the appended drawings. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities of the embodiments shown in the drawings.

FIG. 1 is a top perspective view of a building panel according to one embodiment of the invention;

FIG. 2 is a cross-sectional view of a building panel according to an embodiment of the present invention, the cross sectional being along the II line set forth in FIG. 1;

FIG. 3 is a side perspective view of a surface covering system according to one embodiment of the invention. The figure includes an acoustic building panel being attached to a furring strip;

FIG. 4 is a schematic view of a surface covering system according to one embodiment of the invention. The figure includes the acoustic building panel, an adhesive tape, and a substrate;

FIG. 5 is a perspective view illustrating a substrate having a plurality of panels thereon and illustrating an additional panel being coupled to the substrate; and

FIGS. 6A-C show a plurality of ceiling panels of various shapes in accordance with exemplary embodiments of the invention.

DETAILED DESCRIPTION

For illustrative purposes, the principles of the present invention are described by referencing various exemplary embodiments thereof. Although certain embodiments of the invention are specifically described herein, one of ordinary skill in the art will readily recognize that the same principles are equally applicable to, and can be employed in other applications and methods. It is to be understood that the invention is not limited in its application to the details of any particular embodiment shown. The terminology used herein is for the purpose of description and not to limit the invention, its application, or uses.

As used herein and in the appended claims, the singular forms "a", "an", and "the" include plural references unless the context dictates otherwise. The singular form of any class of the ingredients refers not only to one chemical species within that class, but also to a mixture of those chemical species. The terms "a" (or "an"), "one or more" and "at least one" may be used interchangeably herein. The terms "comprising", "including", "containing", and "having" may be used interchangeably. The term "include" should be interpreted as "include, but are not limited to". The term "including" should be interpreted as "including, but are not limited to".

As used throughout, ranges are used as shorthand for describing each and every value that is within the range. Any value within the range can be selected as the terminus of the range.

Unless otherwise specified, all percentages and amounts expressed herein and elsewhere in the specification should be understood to refer to percentages by weight of the total composition. Unless otherwise specified, reference to a molecule, or to molecules, being present at a "wt. %" refers to the amount of that molecule, or molecules, present in the composition based on the total weight of the composition.

According to the present application, use of the term "about" in conjunction with a numeral value refers to a value that may be +/-5% of that numeral. As used herein, the term "substantially free" is intended to mean an amount less than about 5.0 wt. %, less than 3.0 wt. %, 1.0 wt. %; preferably less than about 0.5 wt. %, and more preferably less than about 0.25 wt. % of the composition.

Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which this invention belongs. All patents, patent applications, publications, and other references cited or referred to herein are incorporated by reference in their entireties for all purposes. In the event of a conflict in a definition in the present disclosure and that of a cited reference, the present disclosure controls.

In the description of embodiments disclosed herein, any reference to direction or orientation is merely intended for convenience of description and is not intended in any way to limit the scope of the present invention. Relative terms such as "lower," "upper," "horizontal," "vertical," "above," "below," "up," "down," "top" and "bottom" as well as derivatives thereof (e.g., "horizontally," "downwardly," "upwardly," etc.) should be construed to refer to the orientation as then described or as shown in the drawing (if applicable) under discussion. These relative terms are for convenience of description only and, unless specified otherwise, do not require that the apparatus be constructed or operated in a particular orientation.

As used herein, terms such as "attached," "affixed," "connected," "coupled," "interconnected," and the like refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise. Accordingly, the disclosure is not limited to such exemplary embodiments illustrating certain combinations of features that may exist alone or in combination with other features.

The present disclosure is directed towards acoustic building panels and surface covering systems useful to display a desired aesthetic quality and to introduce acoustical solutions. In certain aspects, such panels and systems further impart fire resistant properties.

Referring to FIGS. 1 and 2, according to one embodiment, the acoustic building panel 10 is shown with the fleece 200 covering the upper surface 111 and a side surface 113 of the body 100. In this depiction, the acoustic building panel 10 has a rectangular shape having a length L_p and a width W_p . The second side 201 of the fleece 200 faces away from the body 100 as the fleece 200 wraps around the body 100 of the acoustic building panel.

The acoustic building panel 10 comprises a first major surface 11 opposite a second major surface 12 and a third major side surface 13 extending there-between. The acoustic building panel 10 may have a body thickness t_0 that as

measured by the distance between the first major surface 11 to the second major surface 12.

The acoustic building panel 10 comprises a body 100 in contact with a fleece 200. In certain embodiments, the fleece 200 is laminated onto a surface of the body 100. In certain embodiments, various adhesion compositions may be used to accomplish the lamination.

The body 100 comprises an upper surface 111 opposite a lower surface 112 and a side surface 113 that extends between the upper surface 111 and the lower surface 112, thereby defining a perimeter of the body 100. The body 100 may have a body thickness t_1 that as measured by the distance between the upper surface 111 to the lower surface 112 of the body 100. In certain embodiments, the second major surface 12 of the acoustic building panel 10 and the lower surface 112 of the body 100 may be the same. In other embodiments, the fleece 200 may wrap the entirety of the body 100 and the lower surface 112 of the body 100 are not the same.

The fleece 200 comprises a first side 202 opposite a second side 201. The fleece 200 may have a thickness t_2 as measured from the first side 202 to the second side 201.

In the depiction of FIG. 2, the fleece 200 is shown to contact both the upper surface 111 and the side surface 113 of the body 100. In further embodiments, the fleece 200 is in contact with the upper surface 111, lower surface 112, and the side surfaces 113 of the body 100. In other embodiments, the fleece 200 is in contact with only the upper surface 111 of the body 100.

Referring to FIG. 3, the acoustic building panel 10 may be directly attached to a substrate 20 by use of an attaching means 25. In this non-limiting depiction, the acoustic building panel 10 is attached to the substrate 20 with use of a screw as an attaching means 25. In other non-limiting embodiments, an adhesive or tape may be utilized. In this non-limiting depiction, the substrate 20 comprises a furring strip 21.

Referring to FIG. 4, the acoustic building panel 10 may be detachably coupled, or attached, to a substrate 20 by use of an adhesive tape 120. Although FIG. 4 only illustrates one acoustic building panel 10 being coupled to the substrate 20, in certain embodiments the surface covering system comprises a plurality of the acoustic building panel 10, each of which is detachably coupled to the substrate 20 (see, for example, FIG. 5). Thus, in accordance with the invention set forth herein, a plurality of the acoustic building panels 10 may be coupled to the substrate 20 using the adhesive tape 120, as discussed more fully herein. Specifically, a plurality of the acoustic building panels 10 may be detachably coupled to the substrate 20 (using the adhesive tape 120) in a side-by-side arrangement so that the acoustic building panels 10 collectively cover the substrate 20. As used herein, covering the substrate 20 includes partially covering the substrate 20 and/or covering an entirety of the substrate 20. A user can cover as much of the substrate 20 as he/she desires using one or more of the acoustic building panels 10 and the installation techniques described herein.

The substrate 20 may be any surface that is desirable to cover with one or more of the acoustic building panels 10. For example, the substrate 20 may be a wall to which wall panels are attached, or a ceiling to which ceiling panels are attached. The substrate 20 may be an interior wall (such as drywall, wood, or the like) or an exterior wall (such as siding, stucco, concrete, brick, wood, or the like). Thus, the substrate 20 may be formed of a variety of different materials or compositions, including without limitation wood, metal, brick, plastic, fabric, fibrous sheet, glass, ceramic,

concrete, plastic film/sheet, paper, medium density fiberboard, fiberglass, mineral fiber sheet, drywall, or the like. In certain embodiments the substrate **20** may be drywall that may or may not be covered with paint, wallpaper, or the like. The substrate **20** is illustrated as being flat/planar in the exemplified embodiment, but the invention is not to be so limited in all embodiments and the substrate **20** may be curved in alternative embodiments. Furthermore, the substrate **20** may be horizontal (such as when the substrate is a floor or a ceiling), vertical (such as when the substrate **20** is a wall), or oriented at an angle. The exposed outer surface of the substrate **20** may be a smooth surface, a textured surface, or the like in various embodiments.

The adhesive tape **120** may be an integral laminate structure comprising a panel-side adhesive component **121** having a first surface **122** and a second surface **123** opposite the first surface **122**, a substrate-side adhesive component **124** having a first surface **125** and a second surface **126** opposite the first surface **125**, and a release component **127** having a first surface **128** and a second surface **129** opposite the first surface **128**. In other embodiments the panel-side adhesive component **121** may not be integral with the substrate-side adhesive component **124**, but rather these may be separate components that are only attached to one another when the acoustic building panel **10** are being installed on the substrate **20**. Thus, the panel-side adhesive component **121** and the substrate-side adhesive component **124** may be maintained separately (such as in rolls or the like) until such time as they are needed to couple the acoustic building panel **10** to the substrate **20**. In embodiments that maintain the panel-side and substrate-side adhesive components **121**, **124** separately from one another, the release component **127** may be attached to one of the panel-side or substrate-side adhesive components **121**, **124** or the release component may also be maintained separate from the panel-side and substrate-side adhesive components **121**, **124**. Regardless, when the acoustic building panel **10** is coupled to the substrate **20**, the panel-side adhesive component **121**, the substrate-side adhesive component **124**, and the release component **127** are coupled together and collectively form the adhesive tape **120**.

FIG. 5 shows an embodiment of an arrangement of how the acoustic building panel **10** may fit onto a substrate **20**. This figure shows a multitude of acoustic building panels **10** covering a substrate **20**. In this figure, the substrate side adhesive component **124** is shown attached to the substrate **20** and the panel-side adhesive component **121** is shown attached to the acoustic building panel **10**. In this figure one acoustic building panel **10** is shown being placed onto the substrate side adhesive component **124**.

In certain embodiments, the present invention is an acoustic building panel comprising a first major surface opposite a second major surface and a side surface extending there-between, the acoustic building panel comprising a body comprising an upper surface opposite a lower surface and a side surface extending there-between; a fleece having a first side and a second side; wherein the first side of the fleece is in contact with the upper surface of the body; wherein the body and fleece are laminated; and wherein the fleece has a flow resistivity of about 826,100 to about 1,090,900 Pa*/m². In further embodiments, the invention is an acoustic building panel having a first major surface opposite a second major surface and a side surface extending there-between, the acoustic building panel consisting essentially of a body having an upper surface opposite a lower surface and side surfaces extending there-between; a fleece having a first side and a second side; wherein the first side of the fleece is in

contact with the upper surface of the body; wherein the body and fleece are laminated; and wherein the fleece has a flow resistivity of about 826,100 to about 1,090,900 Pa*/m². In further embodiments, the invention is a surface covering system comprising a plurality of acoustic building panels, each of the panels comprising a first major surface opposite a second major surface and a side surface extending there-between, the acoustic building panel further comprising a body having an upper surface opposite a lower surface and side surfaces extending there-between; a fleece having a first side and a second side; wherein the first side of the fleece is in contact with the upper surface of the body; wherein the body and fleece are laminated; and wherein the fleece has a flow resistivity of about 826,100 to about 1,090,900 Pa*/m²; and an adhesive tape configured to detachably couple the panels to a substrate, the adhesive tape comprising: a substrate-side adhesive component comprising at least one adhesive layer and a panel-side adhesive component comprising at least one adhesive layer; and a release component; wherein the panels are detachably coupled to the substrate by the adhesive tape in a side-by-side arrangement to cover the substrate, the at least one adhesive layer of the substrate-side adhesive component being adhered to the substrate, the at least one adhesive layer of the panel-side adhesive component being adhered to the rear surfaces of the panels, and the release component being positioned between the substrate-side adhesive component and the panel-side adhesive component.

The acoustic building panel may be utilized in various aspects. In certain embodiments, the acoustic building panel is a wall panel. In certain embodiments, the acoustic building panel is a ceiling panel. In certain embodiments, the acoustic building panel is used as both a ceiling panel and a wall panel.

The body of the acoustic building panel may be made of varying components. In certain embodiments, the body comprises a nonwoven material. In certain embodiments, the body comprises excelsior material, which also refers to softwood shavings used for stuffing. In certain embodiments, the body comprises aspen wood, non-woven perforated metal, wood, or a combination thereof. In certain embodiments, the body comprises aspen wood excelsior.

The body of the acoustic building panel may have various shapes and sizes. In certain embodiments, the acoustic building panels can have any desired shape. In certain embodiments, the panels shape may include polygons, round shapes, and irregular shapes. For example, the shape may be a triangle, square, rectangle, pentagon, hexagon, or any other polygon. For particular installations, other non-regular shapes may be required to, for example, fit around columns or other abnormalities in the ceiling plan. As further non-limiting examples, FIG. 6A shows a plurality of shapes **710**, **711**, **712**, **713** using a nominal 75 degree angle with respect to a horizontal line. Other shapes having a nominal 75 degree angle can also be used such as, for example, a parallelogram shaped ceiling tile **711** or **712** having a longer or shorter base, or a trapezoid shaped ceiling tile **713** having a longer or shorter base. FIG. 6B shows a plurality of shapes **714**, **715**, **716** using a nominal 60 degree angle with respect to a horizontal line. Other shapes having a nominal 60 degree angle can also be used such as, for example, a parallelogram shaped ceiling tile **715** or **716** having a longer or shorter base, or a trapezoid shaped ceiling tile (not shown). FIG. 6C shows a plurality of shapes **717**, **718**, **719**, **720**, **721** using a nominal 45 degree angle with respect to a horizontal line. Other shapes having a nominal 45 degree angle can also be used such as, for example, a parallelogram

shaped ceiling tile 718 or 719 having a longer or shorter base, or a trapezoid shaped ceiling tile 720 having a longer or shorter base. FIG. 6C also shows a plurality of shapes 722, 723, 724, 725, 726, 727 using other nominal angles with respect to a horizontal line. Other shapes having other nominal angles can also be used such as, for example, a parallelogram shaped ceiling tile, or a trapezoid shaped ceiling tile.

The distance between the upper surface and lower surface of the body may vary. In certain embodiments, the distance between the upper surface and lower surface is about 0.8 inches to about 2.5 inches. In certain embodiments, the distance between the upper surface and lower surface is about 0.8 inches to about 2.0 inches. In certain embodiments, the distance between the upper surface and lower surface is about 0.8 inches to about 1.2 inches. In certain embodiments, the distance between the upper surface and lower surface is about 1.0 inch.

The body of the acoustic building panel may comprise one or more fire retardants. In certain embodiments, the fire retardant is selected from magnesium oxide, sodium silicate, magnesium sulfate, calcium carbonate, ammonium polyphosphate, or a combination thereof. The one or more fire retardants may be present at various amounts or concentrations. In certain embodiments, the one or more fire retardants are present in an amount from about 50 wt. % to about 70 wt. %. In certain embodiments, magnesium oxide may be present in an amount from about 10 to about 25 wt. %. In certain embodiments, sodium silicate may be present in an amount from about 10 to about 25 wt. %. In certain embodiments, magnesium sulfate may be present in an amount from about 5 to about 10 wt. %. In certain embodiments, calcium carbonate may be present in an amount from about 5 to about 10 wt. %.

The fleece may be made from varying materials. In certain embodiments, the fleece comprises fiberglass, sheep wool, cellulosic material, non-woven polymer, or a combination thereof. In certain embodiments, the cellulosic material is selected from cotton, paper, or combinations thereof. In certain embodiments, the non-woven polymer is selected from polyester, polyolefin, polyaramid, or combinations thereof. In certain embodiments, the fleece is made from fiberglass.

The fleece may contain varying basis weight. In certain embodiments, the fleece may have a basis weight from about 40 g/m² to about 150 g/m². In certain embodiments, the fleece may have a basis weight from about 40 g/m² to about 100 g/m². In certain embodiments, the fleece may have a basis weight from about 50 g/m² to about 100 g/m². In certain embodiments, the fleece may have a basis weight of about 100 g/m².

The fleece may contain varying thickness. In certain embodiments, the fleece has a thickness from about 0.15 mm to about 0.60 mm. In certain embodiments, the fleece has a thickness from about 0.15 mm to about 0.50 mm. In certain embodiments, the fleece has a thickness from about 0.15 mm to about 0.40 mm. In certain embodiments, the fleece has a thickness from about 0.15 mm to about 0.35 mm. In certain embodiments, the fleece has a thickness from about 0.20 mm to about 0.50 mm.

The flow resistivity of the fleece makes a significant contribution towards the NRC value. In certain embodiments, the fleece has a flow resistivity of about 826,000 to about 1,100,000 Pa*s/m². In certain embodiments, the fleece has a flow resistivity of about 826,000 to about 1,091,000 Pa*s/m². In certain embodiments, the fleece has a flow resistivity of about 826,000 to about 950,000 Pa*s/m². In

certain embodiments, the fleece has a flow resistivity of about 850,000 to about 900,000 Pa*s/m². In certain embodiments, the fleece has a flow resistivity of about 857,000 Pa*s/m².

In certain embodiments, the fleece has a basis weight from about 40 g/m² to about 150 g/m², a thickness from about 0.15 mm to about 0.60 mm, and a flow resistivity of about 826,100 to about 1,090,900 Pa*s/m². In certain embodiments, the fleece is made of fiberglass, has a basis weight from about 40 g/m² to about 150 g/m², a thickness from about 0.15 mm to about 0.60 mm, and a flow resistivity of about 826,100 to about 1,090,900 Pa*s/m². In certain embodiments, the fleece has a basis weight from about 40 g/m² to about 100 g/m², a thickness from about 0.15 mm to about 0.50 mm, and a flow resistivity of about 826,100 to about 1,090,900 Pa*s/m². In certain embodiments, the fleece is made of fiberglass, has a basis weight from about 40 g/m² to about 100 g/m², a thickness from about 0.15 mm to about 0.50 mm, and a flow resistivity of about 826,100 to about 1,090,900 Pa*s/m².

The acoustic building panel may be laminated using various adhesives known in the art. In certain embodiments, the adhesive is a two component cross-linking diisocyanate waterborne emulsion. In other embodiments, the adhesive is an aqueous polyvinyl acetate emulsion. In certain embodiments, a water based adhesive using emulsion polymer isocyanate may be used. In other embodiments, a polyurethane based adhesive may be used. In some embodiments the adhesive may be a pressure sensitive adhesive, a hot melt adhesive, or a combination thereof. In some embodiments, the adhesive comprises a hot melt adhesive. In some embodiments, the adhesive comprises a pressure sensitive adhesive. In some embodiments, the adhesive comprises polyvinyl acetate. In some embodiments, the adhesive comprises ethylene vinyl-acetate (EVA).

In certain embodiments, the adhesive is applied at 8 to 30 g/ft². In certain embodiments, the adhesive is applied at 10 to 25 g/ft². In certain embodiments, the adhesive is applied at 12 to 20 g/ft². In certain embodiments, the adhesive is a two component cross-linking diisocyanate waterborne emulsion applied at 10 to 25 g/ft². In certain embodiments, the adhesive is a two component cross-linking diisocyanate waterborne emulsion applied at 15 to 25 g/ft². In certain embodiments, the adhesive is an aqueous polyvinyl acetate emulsion applied at 8 to 25 g/ft². In certain embodiments, the adhesive is an aqueous polyvinyl acetate emulsion applied at 8 to 15 g/ft².

An important characteristic for building panel materials is the ability to reduce the amount of reflected sound in a room. One measurement of this ability is the Noise Reduction Coefficient (NRC) rating as described in ASTM test method C423. This rating is the average of sound absorption coefficients at various octave bands (e.g., 100, 250, 500, 1000, and 2000 Hz), where, for example, a system having an NRC of 0.90 has about 90% of the absorbing ability of an ideal absorber. A higher NRC value indicates that the material provides better sound absorption and reduced sound reflection. However, the sound absorption of a material that covers a flat surface depends not only on the physical properties of the material but also on the way in which the material is mounted over the surface. ASTM test method E75 provides test specimen mounting types (e.g., D-20, E-400) to be used during sound absorption tests. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.65 to about 0.90 as determined in an E-400 mount. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.90 as

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determined in an E-400 mount. In certain embodiments, the acoustic building panel has a noise reduction coefficient (NRC) of about 0.55 to about 0.60 as determined in a D-20 mount.

Another important characteristic for building panel materials is the burning performance. ASTM E84-20 provides methods to determine the relative burning behavior of the material. In particular, ASTM E84-20 provides methods for determining the Flame Spread Index (FSI) which characterizes how far flames generated on the test material spread. The FSI is measured from 0 (indicating no flames) to 200 (which indicates spreading flames). ASTM E84-20 also provides methods for determining the Smoke Developed Index (SDI) which states how much smoke is generated. SDI is measured on a scale of 0 to 450, which correlates to no smoke generated (value of 0) to thick, heavy smoke (value of 450). Obtained FSI and SDI values are then compiled and applied to a three-tiered class system: Class A, Class B, and Class C, with Class A rated materials producing minimal to no flames or smoke, while Class C materials producing the most flames or smoke. In order to qualify as an E84 Class A fire rating, a flame spread index (FSI) of 25 or less and smoke developed index at 450 or less must be exhibited. In certain embodiments, the acoustic building panel has a flame spread index (FSI) of about 0 to about 10, as determined by ASTM E84-20. In certain embodiments, the acoustic building panel has a flame spread index (FSI) of about 10 as determined by ASTM E84-20. In certain embodiments, the acoustic building panel has a flame spread index (FSI) of about 0 as determined by ASTM E84-20. In certain embodiments, the acoustic building panel has a smoke developed index (SDI) of about 5 or less as determined by ASTM E84-20.

The acoustic building panel may be attached to a substrate, thus creating a surface covering system. Without intending to be limited, the acoustic building panel may be included in a removable surface covering system using adhesive components as disclosed in U.S. Patent Application No. 2019/0270275, filed Mar. 2, 2019. In other embodiments, the acoustic building panel may be directly attached to a substrate using an attaching means, such as, but not limited to, a nail.

EXAMPLES

The examples and other implementations described herein are exemplary and not intended to be limiting in describing the full scope of compositions and methods of this disclosure. Equivalent changes, modifications and variations of specific implementations, materials, compositions, and methods may be made within the scope of the present disclosure, with substantially similar results.

Example 1: To the back of about one inch thick panels (Panels a-d) comprising aspen wood excelsior was added a glass fiber fleece of varying density, thickness, and flow resistance as shown in Table 1. The panels further comprised magnesium oxide, sodium silicate, magnesium sulfate, and calcium carbonate.

TABLE 1

Fiberglass fleeces.				
Fleece	Basis Weight (g/m ²)	Thickness (mm)	Flow Resistance (Pa · S/m)	Flow Resistivity (Pa · s/m ²)
a	40	0.17	≥120	705,882
b	50	0.23	≥190	826,087

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TABLE 1-continued

Fiberglass fleeces.				
Fleece	Basis Weight (g/m ²)	Thickness (mm)	Flow Resistance (Pa · S/m)	Flow Resistivity (Pa · s/m ²)
c	100	0.35	≥300	857,143
d	150	0.55	≤600	1,090,909

The panels A-D, which corresponds to a panel having a fleece a-d respectively, were tested to determine the Noise Reduction Coefficient (NRC) for each panel. A control panel was also tested which was a panel not having a fleece. Table 2 shows the results of the tests.

TABLE 2

Determination of noise reduction coefficient.		
Panel	E-400 Mount NRC	D-20 Mount NRC
Control	0.4	—
A	0.65	—
B	0.75	0.55
C	0.85	0.60
D	0.85	0.60

Regarding mounting types, the “E” designates a sealed air space behind the panel and the number after the “E” is the depth of the airspace in millimeters. The “D” mounting type corresponds to the panel being mounted on wood furring strips. As shown in Table 2, use of fleece c and d nearly doubled the NRC value as compared to the control.

Example 2: Various adhesion systems were tested for their effects on NRC value and fire resistivity. Fire testing was performed according to methods established by ASTM E84-20 (ASTM International). Panel A was laminated using a two component cross-linking diisocyanate waterborne emulsion (Isoset™ from Ashland™) at about 20 g/ft². Panel C was laminated at about 12 g/ft² with either a two component cross-linking diisocyanate waterborne emulsion or an aqueous polyvinyl acetate emulsion (Aqueuce WL 5704, Henkel) as adhesive.

TABLE 3

Effects of Adhesive.					
Panel	Adhesive	E-400 Mount NRC	D-20 Mount NRC	Flame Spread Index (FSI)	Smoke Developed Index (SDI)
A	Two component cross-linking diisocyanate waterborne emulsion			10	0
C	Two component cross-linking diisocyanate waterborne emulsion	0.90	0.60	0	5
C	Aqueous polyvinyl acetate emulsion	0.90	0.60	0	5

In order to qualify as an E84 Class A fire rating, a flame spread index of 25 or less and smoke developed index at 450 or less must be exhibited. Surprisingly and unexpectedly, as

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shown in Table 3, the panels exhibited superior fire resistive properties. More so, utilization of a fleece c, which has a flow resistivity of 857,143 Pa*s/m², surprisingly and unexpectedly provided improved flame spread performance as compared to use of fleece a, which has a flow resistivity of about 705,882 Pa*s/m².

While the present invention has been described with reference to several embodiments, which embodiments have been set forth in considerable detail for the purposes of making a complete disclosure of the invention, such embodiments are merely exemplary and are not intended to be limiting or represent an exhaustive enumeration of all aspects of the invention. The scope of the invention is to be determined from the claims appended hereto. Further, it will be apparent to those of skill in the art that numerous changes may be made in such details without departing from the spirit and the principles of the invention.

What is claimed is:

1. An acoustic building panel comprising a first major surface opposite a second major surface and a third major side surface extending there-between, the acoustic building panel comprising:

- a body comprising an upper surface opposite a lower surface and a side surface extending there-between;
- a fleece having a first side opposite a second side and a basis weight ranging from about 40 g/m² to about 100 g/m²;

wherein the first side of the fleece is in contact with the upper surface of the body;

wherein the body and fleece are laminated; and

wherein the fleece has a flow resistivity of about 826,100 to about 1,090,900 Pa*s/m².

2. The acoustic building panel of claim 1, wherein the body comprises a nonwoven material.

3. The acoustic building panel of claim 1, wherein the body comprises aspen wood, non-woven perforated metal, or wood.

4. The acoustic building panel of claim 1, wherein the fleece comprises fiberglass, sheep wool, cellulosic material, or non-woven polymer.

5. The acoustic building panel of claim 4, wherein the cellulosic material is selected from cotton, paper, or combinations thereof.

6. The acoustic building panel of claim 4, wherein the non-woven polymer is selected from polyester, polyolefin, polyaramid, or combinations thereof.

7. The acoustic building panel of claim 1, wherein the body comprises fire retardant selected from magnesium oxide, sodium silicate, magnesium sulfate, calcium carbonate, or a combination thereof.

8. The acoustic building panel of claim 1, wherein the acoustic building panel has a noise reduction coefficient (NRC) of about 0.65 to about 0.90 as determined in an E-400 mount.

9. An acoustic building panel having a first major surface opposite a second major surface and a third major side surface extending there-between, the acoustic building panel comprising:

- a body having an upper surface opposite a lower surface and side surfaces extending there-between;
- a fiberglass fleece having a first side opposite a second side and a basis weight ranging from about 40 g/m² to about 100 g/m²;

wherein the first side of the fleece is in contact with the upper surface of the body and at least a portion of the side surfaces of the body;

wherein the body and fleece are laminated; and

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wherein the fleece has a flow resistivity of about 826,100 to about 1,090,900 Pa*s/m².

10. The acoustic building panel of claim 9, wherein the body comprises a nonwoven material.

11. The acoustic building panel of claim 9, wherein the distance between the upper surface and lower surface is about 0.8 inches to about 2.5 inches.

12. The acoustic building panel of claim 11, wherein the distance between the upper surface and lower surface is about 0.8 inches to about 1.2 inches.

13. The acoustic building panel of claim 11, wherein the distance between the upper surface and lower surface is about 1.0 inch.

14. The acoustic building panel of claim 9, wherein the body comprises fire retardant comprising one or more of magnesium oxide, sodium silicate, magnesium sulfate, and calcium carbonate.

15. The acoustic building panel of claim 9, wherein the acoustic building panel has a noise reduction coefficient (NRC) of about 0.65 to about 0.90 as determined in an E-400 mount.

16. A surface covering system comprising:

- a plurality of acoustic building panels, each of the panels comprising a first major surface opposite a second major surface and a third major side surface extending there-between, the acoustic building panel further comprising:

a body having an upper surface opposite a lower surface and side surfaces extending there-between;

a fleece having a first side opposite a second side and a basis weight ranging from about 40 g/m² to about 100 g/m²;

wherein the first side of the fleece is in contact with the upper surface of the body;

wherein the body and fleece are laminated; and wherein the fleece has a flow resistivity of about 826,100 to about 1,090,900Pa*s/m²; and

an adhesive tape configured to detachably couple the panels to a substrate, the adhesive tape comprising: a substrate-side adhesive component comprising at least one adhesive layer;

a panel-side adhesive component comprising at least one adhesive layer; and a release component;

wherein the panels are detachably coupled to the substrate by the adhesive tape in a side-by-side arrangement to cover the substrate, the at least one adhesive layer of the substrate-side adhesive component being adhered to the substrate, the at least one adhesive layer of the panel-side adhesive component being adhered to the rear surfaces of the panels, and the release component being positioned between the substrate-side adhesive component and the panel-side adhesive component.

17. The surface covering system of claim 16, wherein the distance between the upper surface and lower surface is about 0.8 inches to about 2.5 inches.

18. The surface covering system of claim 16, wherein the acoustic building panel has a noise reduction coefficient (NRC) of about 0.65 to about 0.90 as determined in an E-400 mount.

19. The surface covering system of claim 16, wherein the acoustic building panel has a noise reduction coefficient (NRC) of about 0.55 to about 0.60 as determined in a D-20 mount.

20. The surface covering system of claim 16, wherein the acoustic building panel is a wall or ceiling panel.